K_s^0 and $\Lambda(\overline{\Lambda})$ Production in $d+Au$ Collisions at $\sqrt{s_{NN}}$ = 200 GeV at RHIC

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The Relativistic Heavy Ion Collider (RHIC) experiments are designed to search for a new phase transition in nucleus-nucleus collisions called Quark-Gluon Plasma (QGP) which is predicted by the lattice QCD calculation on the bulk nuclear matter. The QGP may be detected indirectly by studying partonic energy loss in dense medium using inclusive spectra of high transverse momentum (high p_T) hadrons. The nuclear modification factor R_{CP} and the closely related one R_{AA} are a measure of the particle production dependence on the collision system size and density:

$$R_{CP}(p_T) = \frac{[(dN/dp_T)/N_{bin}]^{Central}}{[(dN/dp_T)/N_{bin}]^{Peripheral}} \qquad (1)$$

Recent results from $Au+Au$ collisions at $\sqrt{s_{NN}}$ = 130 and 200 GeV at RHIC show strong suppression of charged hadron yields at the moderate and high p_T , i.e. R_{CP} and R_{AA} are below unity [1]. This suppression is an indication that energetic partons lose their energy when traversing the dense medium formed in the final state following the hard scattering. The alternative explanation is that the suppression might result from initial-state effects prior to the hard scattering, such as the saturation of gluon densities in the incoming nuclei. Since in deuteron(d)+Au collisions no hot and dense medium is expected to be created and the partonic energy loss is thought to be negligible, analysis of d+Au collision data will help us discriminate these two models. The current measurements on R_{AA} of charged hadrons in $d+Au$ central and minimum bias collisions show that no suppression is observed [2]. Instead the Cornin effect plays a significant role in $d+Au$ collisions for $2 \leq p_T \leq 7$ GeV/c. This measurement supports the first explanation that suppression in the central $Au+Au$ collisions are due to final-state effect where partonic energy loss is significant.

Recent analysis of R_{CP} on neutral particles K_s^0 and $\Lambda(\overline{\Lambda})$ in $Au+Au$ collisions at = 200 GeV show that at intermediate p_T , *e.g.* 2.0 - 5.0 GeV/c, the $\Lambda(\overline{\Lambda})$ R_{CP} is larger than the K_s^0 [3]. This particle-type dependence feature at intermediate p_T contradicts the hadroniztion model of parton energy loss followed by standard fragmentation and supports the coalescence process for hadron formation approach.

In order to study the Cornin effect on particles other than charged hadrons and the particle-type dependence feature, we measured the yields and R_{CP} of K_s^0 and $\Lambda(\overline{\Lambda})$ in $d+Au$ collisions at $\sqrt{s_{NN}}$ = 200 GeV. Both K_s^0 and $\Lambda(\overline{\Lambda})$ were reconstructed via weak decays. The charged daughter particles, pions and protons, are detected in the STAR Time Projection Chamber(TPC). The large decay length in weak decays allows to apply the topology cuts to reduce the background efficiently when V0 hadrons, like K_s^0 and $\Lambda(\overline{\Lambda})$, are reconstructed. Three multiplicity bins are defined in $d+Au$ collisions at STAR: most central collisions(0-20%), middle central collisions(20-40%) and peripheral collisions(40-100%). The ratios R_{CP} for both K_s^0 and $\Lambda(\overline{\Lambda})$ are shown in figure 1. The numbers of binary collision are 15.1 and 4 for cnetral collisions (0-20%) and peripheral collisions (40-100%), respectively. Also shown in the figure is the ϕ-meson R_{CP} for the purpose of comparison.

In $d+Au$ collisions, similar to R_{AA} of charged hadrons, R_{CP} of all particles are above unity at $p_T \geq 1$ GeV/c. In addition, one noticed that R_{CP} of baryon $\Lambda(\overline{\Lambda})$ rises faster than that of K_s^0 and ϕ. Such particle-type dependence is consistent with the results from $Au+Au$ collisions at RHIC [3]. Although the mass of ϕ-meson is close to that of Λ, the p_T dependence of the ϕ R_{CP} is close to that of K_s^0 suggests that hadron type rather than hadron plays an important role in determining the production at the intermediate p_T region.

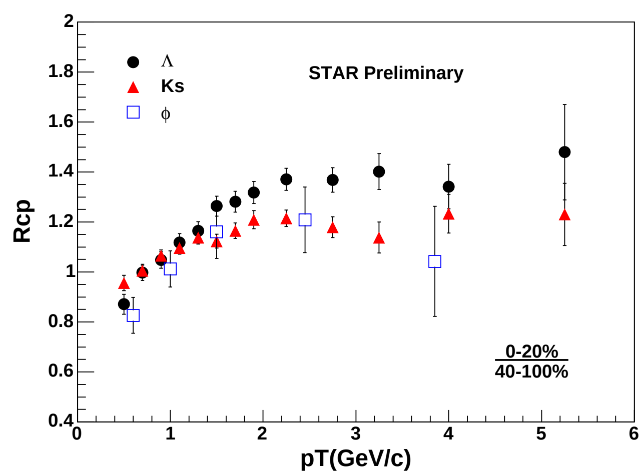

FIG. 1: Nuclear motification factors for K_s^0 (triangles), ϕ (open-squares), and $\Lambda(\overline{\Lambda})$ (dots). Data are extracted from $\sqrt{s_{NN}}$ = 200 GeV $d+Au$ collisions and error bars are statistical only.

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[2] STAR Collaboration, J. Adams *et al.*, Phys. Rev. Lett. 91, 072304 (2003).
[3] STAR Collaboration, J. Adams *et al.*, Phys. Rev. Lett. 92, 052302 (2004).